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ABSTRACT

Research was performed to determine whether: (1) highly creative subjects would obtain higher scores on tests of crativity in an enriched environment, (2) subjects who are poor in creativity will not obtain higher scores because of low perceptual curiosity, and (3) high- and low-intelligence subjects would score equally well on creativity. The population for the research consisted of grade five students. These students answered a peer nomination questionnaire and the Canadian Lorge Thorndike Intelligence Test, Form 1, Level C. Their teacher also completed the teacher nomination questionnaire. On the basis of these measures, 64 subjects were selected. The results are tabulated and discussed. The most important of the educational implications of the findings is that both low- and high-creative subjects are able to utilize appropriate cues from the physical environment while answering Torrance Tests of Creativity, demonstrating the value of enriched and varied environment. The same does not apply to above and below average IQ groups of subjects. Appendixes provide the Peer Nomination Questionnaire and the Teacher Nomination Questionnaire. (DB)

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# PHYSICAL ENVIRONMENT IN RELATION TO CREATIVITY AND INTELLIGENCE

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'Environment' can be of two major types - social and physical. Social environment must include 'significant others' as an essential and dominant component. It has been studied rather extensively in relation to creative behavior, leading to certain widely known and educationally useful generalizations. Physical environment, by definition, must consist entirely of inanimate objects. There has been precious little research regarding the quality of behavior noticeable when human beings are encouraged to react to tests of creativity in appropriately improvised physical environment. The present research is a modest attempt at filling in this gap.

The main rationale of the investigation was as follows:

Curiosity is an integral part of creative behavior (Torrance, 1966). It has two major components - perceptual and epistemic (Berlyne, 1954, 1960). By virtue of the former, human beings tend to scan their environment routinely and habitually, receive and absorb a wider range of stimuli, and, as a result, acquire familiarity with it. If this is true, certain logical inferences which follow from it should also prove to be true. Two of them are:

(a) highly creative subjects would obtain higher scores on tests of creativity when answering the latter in an environment enriched by relevant inanimate objects than they would in another environment devoid of such objects.

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(b) The subjects who are poorly creative will have low perceptual curiosity and, therefore, (a) will not hold true for them.

The scope of the investigation was extended by including a subsidiary rationale also. It is based upon the assertion that intelligence and curiosity are relatively independent of one another - an assertion which has been confirmed sporadically through the years (McCloy and Meier, 1939; Getzels and Jackson, 1959, 1962; Taylor and Holland, 1962; Torrance, 1962; Golann, 1963; McNemar, 1964; Wallach and Kogan, 1965; Hudson, 1966). If this is valid, one would hope that:

(c) High and low intelligence subjects would score equally well on creativity.

Three null hypotheses generated by the above logical inferences and a few additional ones were tested in a three factor fixed design, described below.

Factor A: It represented two types of physical environment created in the same testing room. One type of environment consisted simply of the bare walls of the room itself and fifty percent of the subjects were tested in it. The other type of environment contained carefully arranged forty-seven inanimate objects which could be used as keyed responses for the items of the Torrance Tests of Creative Thinking, Verbal Test, Form B. The latter furnished the criterion measures for the research.

Factor B: It contained high and low creativity subjects.

Factor C: It also had two levels, viz., above and below average I.Q. children.

The population for research consisted of the grade five students of Edmonton Public School Board in 1970. A sample of eleven elementary schools from a total of 144 such schools was drawn at random. They had 719 fifth graders in them. These students answered a peer nomination questionnaire (appendix 1) and the Canadian Lorge Thorndike Intelligence Test, Form 1, Level C. Their teachers also completed the teacher nomination questionnaire (appendix 2). On the basis of these three measures, 64 subjects were selected such that each of the cells in Fig. 1 had 8 of them. Thus 32 were highly creative, 32 low in creativity; 32 answered the Torrance Tests of Creative Thinking in 'enriched' environment and an equal number in the ordinary environment; 32 had above average IQ and the same number had below average.

Factor A: Environment

| Factor B: Creativity | $A_1$ cue-rich | $A_2$ cue-poor | Factor C: Intelligence |
|---|---|---|---|
| Highly Creative $B_1$ | n = 8 | n = 8 | High IQ $C_1$ |
| | n = 8 | n = 8 | Low IQ $C_2$ |
| Low in Creativity $B_2$ | n = 8 | n = 8 | High IQ $C_1$ |
| | n = 8 | n = 8 | Low IQ $C_2$ |

Fig. 1: Subjects Classified by Type of Environment, level of Creativity and that of Intelligence.

The entries in the cells of Fig. 1 were the scores of the subjects on the Torrance Tests, each representing the overall performance of a subject on fluency, flexibility, and originality put together - the three of the four well-known components of creativity on which the Torrance Tests can be scored. They will be called 'criterion' hereinafter. The results of the analysis are given in Table 1, showing that three of the seven hypotheses tested had significant F's associated with them. We would now discuss them and relate them to the three logical inferences mentioned under the rationale of this research.

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Insert Table 1 about here

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The interaction of factors A and B was significant, showing that the high and low creativity groups ($B_1$ and $B_2$) performed differentially on the Torrance Tests while answering them in 'cue-rich' and 'cue-poor' environments ($C_1$ and $C_2$). Table 2 gives a further insight into the nature of the observed interaction.

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Insert Table 2 about here

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Because of significant AB interaction, a routine examination of the overall main effects A and B (through their respective F values 33.01 and 85.32 is meaningless. Simple main effects - $AB_1$ and $AB_2$ - were, therefore, tested and found as follows:

Simple Main Effect $AB_1$:

An examination of $AB_1$ attempts to answer the question: how did highly creative subjects perform when answering the Torrance Tests

in cue-rich and cue-poor environments? This is simply a restatement of logical inference (a) described earlier. The t ratio associated with it was:

$$t = \frac{187.31 - 105.88}{\sqrt{2/N\ (MS_e)}} = \frac{81.43}{\sqrt{2/16\ (335.51)}} = \frac{81.43}{6.67}$$

$$= 12.21$$

The t is significant at $\alpha = .01$ both for one-tailed and two-tailed tests, using 56 as degrees of freedom. This shows that comparable groups of highly creative subjects did not perform equally well in the two types of environment - those answering the Torrance Tests in cue-rich environment had a clear and decisive advantage over their counterparts. Inference (a) is, thus, sustained beyond a reasonable doubt.

Simple Main Effect $AB_2$

An examination of $AB_2$ attempts to answer the corresponding question about low creative subjects. It tells us how they did when answering the Torrance Tests in cue-rich and cue-poor environments. The t ratio associated to it was:

$$t = \frac{81.50 - 68.50}{\sqrt{2/N\ (MS_e)}} = \frac{13.00}{6.67} = 1.95$$

The t value in this case is not significant at $\alpha = .05$, d.f. being 56 again. This result is valuable in demonstrating that low creative persons do not do better in the cue-rich environment on the criterion. Obviously, then, inference (b) above has also been substantiated.

Overall effect for factor C was non-significant, showing that above and below average IQ subjects did equally well on the criterion, proving the validity of inference (c) above. Again, the absence of AC interaction shows that it did not matter whether the subjects were above or below mean IQ and, simultaneously, whether they answered the Torrance Tests in cue-rich or cue-poor environments.

The educational implications of the findings are several. The most important of them is that both low creative and highly creative subjects are able to utilize appropriate cues from the physical environment while answering Torrance Tests of Creativity, demonstrating the value of enriched and varied environment. The same does not apply to above and below averages IQ groups of subjects, however.

Table 1

Summary of Results of Analysis of Variance

| Source of Variation | Degree of Freedom | Deviation Sum of Squares | Mean Sum Squares | F |
|---|---|---|---|---|
| Between Subjects | | | | |
| A. (Environment) | 1 | 11071.69 | 11071.69 | 33.01 |
| B (Creativity) | 1 | 28616.33 | 28616.33 | 85.32 |
| AB | 1 | 5611.69 | 5611.69 | 16.73 |
| C (Intelligence) | 1 | 1.33 | 1.33 | <1 |
| AC | 1 | 88.02 | 88.02 | <1 |
| BC | 1 | 30.08 | 30.08 | <1 |
| ABC | 1 | 379.69 | 379.69 | 1.13 |
| Within Cells | 56 | 18783.08 | 335.51 | |
| Total | 191 | 101009.92 | | |

Table 2

Sample Sizes, Means and Standard Deviations on the Criterion, Classified by Types of Physical Environment and Levels of Creativity of the Subjects

| | | Environment | |
|---|---|---|---|
| | | Cue-rich $A_1$ | Cue-poor $A_2$ |
| Creativity of Subjects | High $B_1$ | N=16<br>$\bar{X}$=187.31<br>s=48.17 | N=16<br>$\bar{X}$=105.88<br>s=23.77 |
| | Low $B_2$ | N=16<br>$\bar{X}$=81.50<br>s=16.07 | N=16<br>$\bar{X}$=68.50<br>s=27.56 |

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Appendix 1

PEER NOMINATION QUESTIONNAIRE

Student_____ Grade_____

School_____ Date_____

1. Which children in your class come up with the most ideas? These are children who seem to be "just running over with ideas," though not always the most talkative. Some of their ideas may not be of very high quality.

(1)_____ (2)_____ (3)_____

(4)_____ (5)_____

Which are the least likely?

(1)_____ (2)_____ (3)_____

(4)_____ (5)_____

2. Which children in your class are the most likely to find a new way of meeting the problem if the situation changed or if a solution to a problem would not work?

(1)_____ (2)_____ (3)_____

(4)_____ (5)_____

Which are the least likely?

(1)_____ (2)_____ (3)_____

(4)_____ (5)_____

3. Which children in your class have the most original or unusual ideas? They think of ideas and solutions which are different from others in the class and from the text.

(1)_____ (2)_____ (3)_____

(4)_____ (5)_____

Which have the least original ideas?

(1)_____ (2)_____ (3)_____

(4)_____ (5)_____

4. Which children in your class are best at thinking of all the details involved in working out a new idea and thinking of all the consequences?

(1)_____ (2)_____ (3)_____

(4)_____ (5)_____

Which are the least able to think of details?

(1)_____ (2)_____ (3)_____

## Appendix 2

### TEACHER NOMINATION QUESTIONNAIRE

Teacher_____ Grade_____

School_____ Date_____

1. Which children in your class are the most fluent in the production of ideas? These are children who seem to be "just running over with ideas," though not always the most talkative. Some of their ideas may not be of very high quality.

   (1) _____ (2) _____ (3) _____

   (4)_____ (5)_____

   Which are the least fluent?

   (1) _____ (2) _____ (3) _____

   (4)_____ (5)_____

2. Which children in your class are the most flexible in their thinking, and in the production of ideas? When one plan or procedure fails, they come up immediately with a different approach. They employ a variety of strategies or approaches in sovling problems. They readily abandon unproductive approaches although they do not abandon the goal; they simply find some other way of achieving the goal.

   (1) _____ (2) _____ (3)_____

   (4)_____ (5)_____

   Which are the least flexible?

   (1) _____ (2) _____ (3) _____

   (4)_____ (5)_____

3. Which children in your class are the most original in their thinking? They are able to get away from the obvious and the commonplace and break away from the beaten path. They see relationships and think of ideas and solutions which are different from others in the class and from the textbook. Many, though not all, of their ideas prove to be useful. Some of their ideas are quite surprising, though true.

   (1) _____ (2) _____ (3) _____

   (4)_____ (5)_____

Which are the least original?

(1) _____ (2) _____ (3)_____

(4)_____ (5)_____

4. Which children in your class are the best in elaborating ideas? They are able to take an idea or a task and spell out the detail. They can take a simple idea and "embroider" it to make it fancy and attractive. Their drawings are very detailed and they are able to develop very detailed or thorough plans for projects.

(1) _____ (2) _____ (3) _____

(4)_____ (5)_____

Which are the least able to elaborate?

(1) _____ (2) _____ (3) _____

(4)_____ (5)_____